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A MIOCENE GLYPTODONT FROM VENEZUELA

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INTRODUCTION

Until recently, very little was known of pre-Pleistocene South American mammals outside of Argentina. A few scattered finds had been made in Uruguay, Peru, Bolivia, Brazil, Venezuela, and Colombia, but the data were scanty, indeed, and cast little light on the history of the great South American fauna except as this could be followed in the marginal region of the Argentine. Recently a series of rich Tertiary mammalian faunas has been found in Colombia by Dr. R. A. Stirton.[1] These will go far towards supplying the needed information, but the need for more widespread Tertiary mammal discoveries in South America remains urgent. As Stirton's work will provide a standard sequence for part of the Tertiary in northern South America, isolated discoveries in adjacent regions will become more useful and important than before, because of increasing possibility of close correlation and dating.

It is thus particularly gratifying to report in this paper the discovery of a Miocene glyptodont, as an addition to the slender list of known Venezuelan Tertiary mammals. Stirton (*in* Royo y Gómez, 1946) has reported, but has not yet described, Miocene glyptodonts in Colombia, and publication of this Venezuelan specimen may therefore permit a tie-in with his sequence.

Previous published accounts of identified Tertiary mammals from Venezuela, as far as known to me, include only the following:

Gyrinodon quassus, Miocene or Pliocene, from near the El Mene oil field, Falcón. See Parkinson (1928) and Hopwood (1928).

?*Nesodon* sp., probably Miocene, from near San Pedro, Falcón. See Schaub (1935).

Prepotherium venezuelanum, probably Miocene, from near Tucupido, Portuguesa. See Collins (1934).

Xenastrapotherium christi, Miocene, from near Zaraza, Guárico. See Stehlin (1928) and Kraglievich (1928).

The specimen now to be described was found by Dr. R. Martin while making a geological study for the Venezuelan Oil and Transport Company. It was brought to Caracas and there studied by J. U. Todd, paleontologist for the Caribbean Petroleum Company, an associated corporation. Professor Walter Bucher of Columbia University, while visiting Venezuela in 1945, suggested to Mr. Todd that I would be interested in this find and asked Mr. Todd to send me a description and illustrations of the specimen. Mr. Todd consequently sent me five photographs, several excellent drawings, and an accurate summary description of the fossil and of its origin. On receipt of my reply, which pointed out that the specimen is a new and important fossil and should be published, Mr. Todd generously relinquished preparation of the technical description to me.

In 1946, D. B. Kemball-Cook, of the Venezuelan Oil and Transport Company, arranged to have the specimen presented to the Venezuelan government, with the recommendation that it be forwarded to me for study. My friend and colleague Dr. Victor M. Lopez, Director of the Servicio Técnico de Geología y Minería of the Ministerio de Fomento of the United States of Venezuela, arranged to have me study the original specimen and had it shipped to New York for this purpose. As received,

[1] Technical details have not yet been published, but Royo y Gómez (1946) has written a general account, with preliminary faunal lists supplied by Stirton.

the specimen had been well prepared by Mr. Todd, and some additional preparation was done in the American Museum of Natural History by J. Walsh. Photographs have been taken by the Museum's photographic section and drawings made by J. C. Germann.

I am greatly indebted to all these gentlemen for their cooperation.

TAXONOMY

ORDER ENDENTATA CUVIER, 1798

SUBORDER XENARTHRA COPE, 1889

INFRAORDER CINGULATA ILLIGER, 1811

Family **Glyptodontidae** Burmeister, 1879

Subfamily **Propalaeohoplophorinae** Castellanos, 1932

GENUS **ASTEROSTEMMA** AMEGHINO, 1889

Asterostemma venezolensis, new species

TYPE: Most of the carapace and the anterior end of the left lower jaw, in the collections of the Ministerio de Fomento, Venezuela.

HYPODIGM: The type only.

HORIZON AND LOCALITY: Santa Ineş formation, considered approximately middle Miocene, on the banks of the Río Guere, near the village of San Francisco, northwestern Anzoategui, in eastern Venezuela. (Data from J. U. Todd.)

DIAGNOSIS: A glyptodont of early Miocene aspect with presence of one series, only, of intercalary scales between adjacent central scales normal throughout the carapace. Intercalary scales normally crossing scute sutures. Usually eight intercalary scales in contact with each central scale. Distinction from scutes of *Asterostemma depressa* not sharply definable because of very inadequate knowledge of that species, but its type scutes have the intercalary scales somewhat smaller, the central scales more posterior on the scutes, and the whole pattern less regular than is usual on scutes of comparable size in *Asterostemma venezolensis*. No scutes with bosses. Posterior margin of carapace nearly smooth. First two mandibular teeth simpler than in later glyptodonts but relatively complex in comparison with Santacrucian forms, most nearly resembling *Propalaeohoplophorus minus*.

DESCRIPTION

When found, the fossil was lying on its left side partly embedded in sandstone, with the right side exposed. Scattered fragments of the right side were found along the shore of the river, and most of these have been restored to their correct positions. As prepared, the specimen includes most of the carapace, but it lacks the anterior and lateral margins as well as all but a short segment (six scutes) of the posterior margin. Several isolated scutes and small groups of scutes, not united to the main part of the carapace, are preserved, and these include two contacting proximal caudal scutes. A jaw fragment was found among the scattered scutes and is believed to represent the same individual. Some internal skeletal elements were seen by Mr. Todd in the hard sandstone that fills the carapace, but these were poorly preserved and shattered, and their removal would have endangered the specimen. They were therefore left in place and covered with plaster reinforcement. After discovering the specimen, Dr. Martin returned to the locality several times and searched for further fragments, but none were found, nor were any other mammal bones found.

The lower jaw fragment is the anterior end of the left ramus with the symphyseal margin eroded and the lower margin broken away. A vertical break through the third tooth ends the fragment posteriorly. The first two teeth are well preserved.

The wear surface of the first tooth is 6.6 mm. in greatest diameter, a line approximately anterointernal - posteroexternal, and 3.7 mm. in middle diameter at right angles to this. The outline, more complex than is usual for the first tooth of early glyptodonts, is sufficiently shown in the figure (fig. 1D). The raised central ridge has several small spurs near its midpoint, also

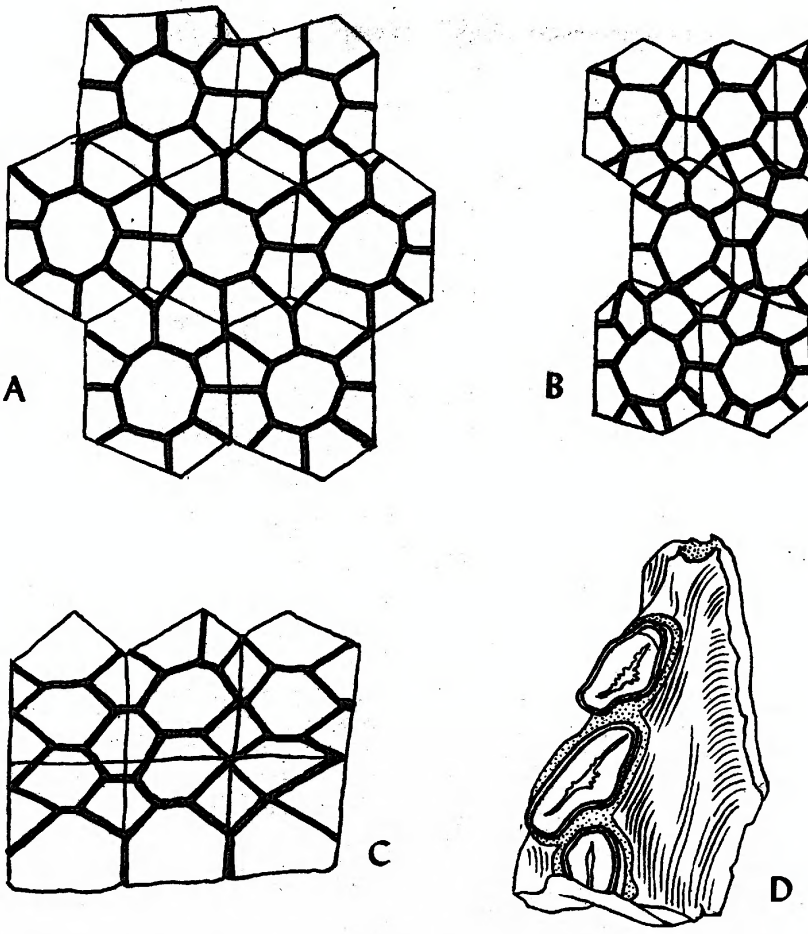

Fig. 1. *Asterostemma venezolensis*, new species. Type. A–C. Diagrams of scale and scute patterns on carapace. Heavy lines represent the grooves indicative of scale boundaries. Light lines indicate sutures between scutes, except posterior (lower) margin of C, which represents a free edge. A. Typical, regular pattern of upper flank region. B. Example of more variable and irregular pattern of more midlateral area near margin. C. Pattern along caudal notch. D. Anterior part of left mandibular ramus with first two teeth and part of third, in dorsal view. In all figures, the anterior direction is upward in the figure. A–C. Two-thirds natural size. D. Twice natural size.

visible in the figure. The second tooth is somewhat similar in shape but is larger, especially more elongate, and has the anterior end turned more inward. Corresponding dimensions are 9.2 and 4.1 mm. The central ridge is simpler.

Only the anterior lobe of the third tooth is preserved. This is a simple, rounded projection, directed almost straight forward along the lingual side of the jaw, internal to the posterior end of the second tooth. On the wear surface, the width of this lobe is 3.4 mm. The vertical break posterior to this shows that the tooth expanded to at least 4.9 mm. immediately posterior to the anterior lobe, which, at the ventral break 26.5 mm. below the wear surface, is still of the same form and size.

The bone of the jaw fragment shows no special peculiarities in comparison with *Propalaeohoplophorus*.

The general form of the carapace is obscured by the rather severe lateral crushing, but seems to have presented no striking differences from *Propalaeohoplophorus* or other primitive glyptodonts. The general

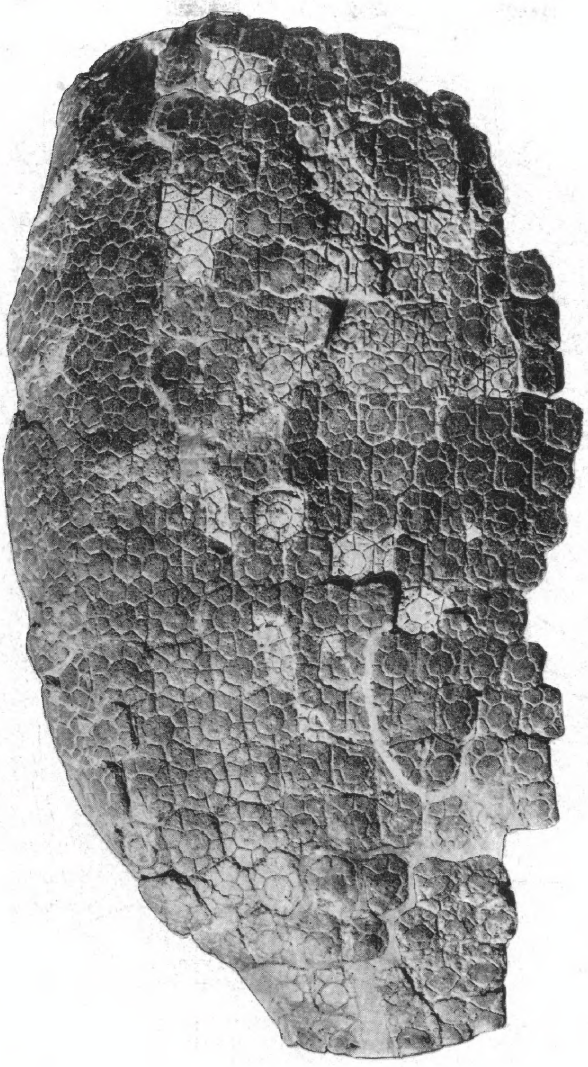

Fig. 2. *Asterostemma venezolensis*, new species. Type. Right side of carapace as preserved. The lighter scutes are restored. One-fourth natural size.

convexity of the shell is seen to be modified only by a shallow annular grooving around the posterior end, so that the posterior margin is somewhat upturned or recurved.[1] The over-all length of the preserved part of the carapace is about 52 cm., and the girth near the middle, around the curve from (broken) edge to edge, is about 77 cm.

As is usual in the more primitive glyptodonts, the carapace scutes are arranged in readily definable transverse bands, of which there are 21 as preserved. The anterior margin is lacking, so that the cara-

[1] It may not be absolutely certain that this is posterior rather than anterior and that the orientation here given the carapace is correct. The smooth edge of this margin does, indeed, suggest a nuchal rather than a caudal notch. On the other hand, in allied forms, as far as I know, an upturning of the margin like this is seen around the caudal notch only. The notch also seems to have been larger than would be expected of a nuchal notch. Moreover, the central scale areas tend to be somewhat nearer this end on their corresponding scutes. Such asymmetry is common in glyptodonts and always with the central scales tending to be nearer the posterior ends of the scutes. The size relationships of the plates also are more as in allied forms if this is assumed to be the posterior end.

Fig. 3. *Asterostemma venezolensis*, new species. Type. Left side of carapace as preserved. One-fourth natural size.

pace originally had at least 22 bands and perhaps several, but probably not many, more. A band near the center of the carapace has 33 scutes, from side to side, and when complete had at least two, and probably several more.

There is no evidence of movable bands in the anterolateral region, such as commonly occur in Miocene glyptodonts. These may have been present beyond the broken edge of the specimen as preserved, but, if so, they cannot have been very extensive.

The scutes vary regularly in size, being smaller anteriorly and laterally and larger posteriorly and medially. Approximate widths in millimeters of scutes in a band near the middle of the carapace, in sequence from one broken edge to the other, are: 18, 18, 19, 20, 21, 22, 23, 23, 24, 24, 24, 24, 25, 26, 26, (approximate median line), 25, 25, 25, 24, 24, 24, 24, 24, 24, 24, 23, 22, 21, 19, 19, 18, 18, 18.

The bony scutes are united by sutures that are approximately vertical to the surface and only moderately spicular or interlocking. The sutures all appear to be open, although they are inconspicuous over part of the more dorsal region, and there may here be some tendency for adjacent scutes to fuse.

Most of the scutes are hexagonal, but they tend to be elongated anteroposteriorly, and near the margins particularly the shape is irregular or tends to be rectangular.

The surfaces of the scutes are marked off into separate scale areas by uniformly well-defined, but not particularly broad or deep, grooves. There are follicles, especially near branches in the grooves, but they are few and small. The general bone surface is finely punctate, but otherwise quite smooth. The central scale areas are in some cases very slightly convex, but none of the scale areas are distinctly elevated, protuberant, or knobby.

The central scale areas, in most cases slightly nearer the posterior edge of the scutes, are roughly circular but with considerable irregularity in detail and a tendency to be vaguely polygonal (usually octagonal) in accordance with their contacts with the intercalary scales.

The scale pattern everywhere shows considerable variation in detail, but over much of the carapace, and especially on the upper flanks and in the middorsal region, it tends to follow a rather regular plan (see fig. 1A). In this typical plan, each central scale is surrounded by eight intercalary scales, each of which extends over the scute suture onto the adjacent scute and to the next central scale. There is thus, in most cases, only a single intercalary scale between one central scale and the next in any direction. In some of the marginal areas of greater irregularity there may occasionally be two intercalary scales between central scales, but this is nowhere the rule. Except where the scutes are smallest, the intercalary scales are nearly, but not quite, as large as the central scales. The intercalary scales are mostly pentagonal and hexagonal. Where the pattern is most evenly developed, the two intercalary scales on each side between a central scale and those medial and lateral to it in the same band tend to be pentagonal while the two extending anteromedial and anterolateral and the two extending posteromedial and posterolateral are more often hexagonal.

The sizes of central scale areas vary more or less with those of the corresponding scutes, but the variation is not so great. Central scales on smaller scutes are thus larger relative to the scutes than on larger scutes. On the smallest scutes, the central scale may occupy well over half of the area of the scute, leaving little room for intercalary scales. In extreme cases the central scales reach the posterior margin of the scutes, and the small intercalary scales, with respect to any one scute, are anterior and lateral only.

On the marginal ring of scutes around the caudal notch, the central (or better, in this case, the main) scale area occupies the whole posterior half or more of the scute, with only three or two anterior and anterolateral intercalary scales, which here, as elsewhere, extend onto adjacent scutes. The posterior margins of these scutes are nearly straight, without any definite projections.

Two loose scutes making contact with each other are believed to be proximal scutes from a caudal ring, which was probably biseriate (see fig. 4C). Their lateral sutures are straight and the distal sutures, for the next series in the ring, angulate. The external surface of the proximal part was overlapped either by another, more proximal caudal ring or by the caudal notch scutes of the carapace, against which they fit sufficiently well. The surface of the free part, slightly over half of the whole scute, was covered by a single, nearly flat scale.

AFFINITIES; STATUS OF *ASTEROSTEMMA*

The relatively small size of this glyptodont, the smooth scutes with well-defined scale areas, the presence of relatively few and large intercalary scales around the subcircular central scales, the arrangement of the scutes in a rather small number of clearly differentiated transverse bands, and the simple, only very obscurely trilobed first two lower teeth—all these characters resemble those of the primitive glyptodonts

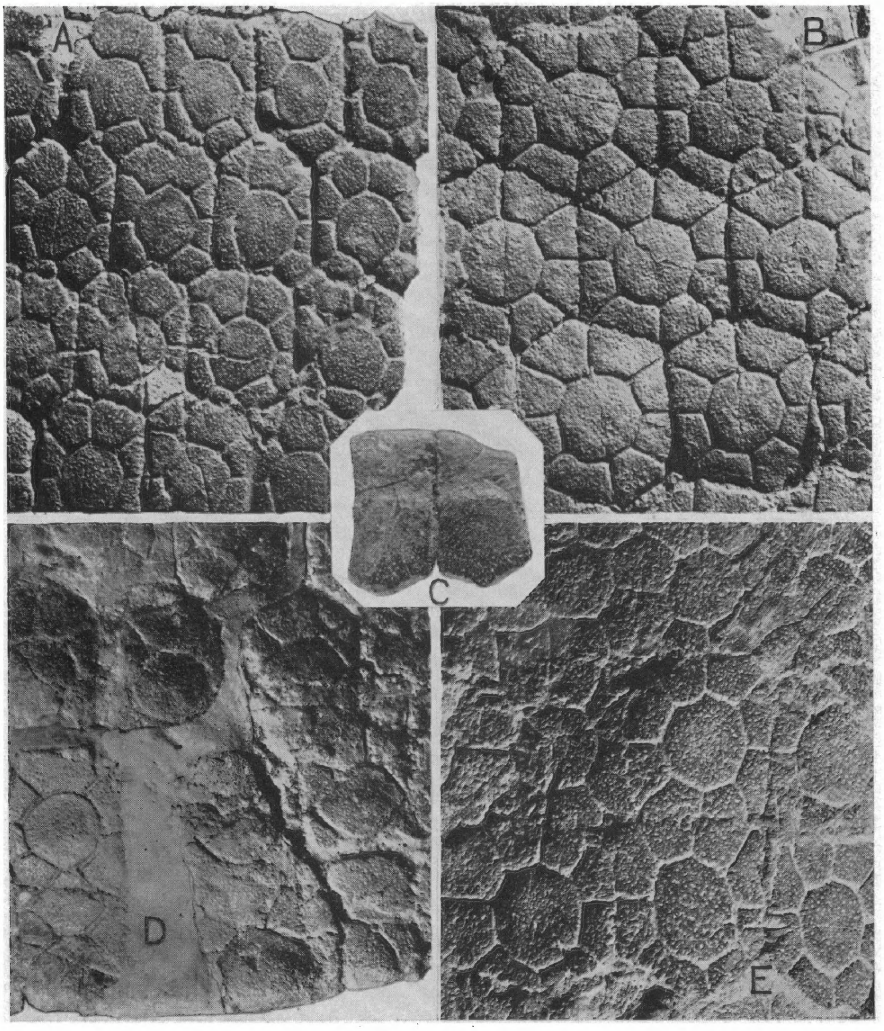

Fig. 4. *Asterostemma venezolensis*, new species. Type. Parts of carapace and caudal tube. A. Scutes in right midlateral region on flank. B. Scutes in right posterolateral region. C. Two caudal tube scutes. D. Scutes near and on the caudal notch of the carapace. E. Scutes in middorsal region, posterior to middle. In all figures, the anterior end is up. All two-thirds natural size.

generally referred to the Propalaeohoplophorinae and exclude close comparison with any later and diversely more specialized forms. The very inadequately known earliest genera *Lomaphorelus* and *Glyptatelus* have no special resemblance, and comparison is to be made primarily with Ameghino's five typically Santacrucian genera: *Propalaeohoplophorus, Cochlops, Eucinepeltus, Metopotoxus,* and *Asterostemma.*

In *Propalaeohoplophorus* there are often only single ranks of intercalary scales between central scales in a dorsolateral or transverse direction, but there are usually two ranks between central scales in an anteroposterior direction. The caudal notch has a serrated or knobby margin. Central scale areas are often convex and somewhat elevated. These same distinctions exist in *Cochlops* and in exaggerated degree. *Cochlops* has, for instance, strong bosses or

tubercles on scutes in the pelvic region, wholly absent in the Venezuelan fossil.

Eucinepeltus was based mainly on a cephalic shield, and little is known, or published, regarding the carapace. Scott (1903) says that this resembles *Propalaeohoplophorus* except for the flatter surface of the scutes. This is a resemblance to the Venezuelan fossil, but the differences from *Propalaeohoplophorus* in scale pattern would, if Scott's statement is literally correct, still apply to *Eucinepeltus*. The type lower teeth of *Eucinepeltus* are quite different from those of the Venezuelan fossil, the first two teeth being simpler and reniform.

In *Metopotoxus*, lower teeth are unknown and the carapace is poorly known, but the type carapace scutes have two regular ranks of intercalary scales between central scales in the anteroposterior direction and they have, in comparison with others of these early forms, unusually conspicuous follicle pits. These characters are not clearly present on any part of the Venezuelan carapace.

Asterostemma was named by Ameghino in 1889, with three species, *A. depressa*, *A. granata*, and *A. laevata*, in that order. In 1898, Ameghino made *A. laevata* the type of a separate genus, *Metopotoxus*, and in 1903 Scott placed *A. granata* in the synonymy of *Cochlops muricatus*. *A. depressa* thus became type of *Asterostemma* by elimination, and no other species have hitherto been described in this genus.

The types of *A. depressa* were two pieces of carapace (possibly associated, although this point was not discussed), one with nine complete scutes and parts of two others, the other with two complete scutes and parts of six. The scutes vary in successive rows from hexagonal to quadrate. The surface is flat or slightly depressed in the central scale area. This area is very near the posterior border on all the preserved scutes. In all directions and in all preserved scutes, only one rank of intercalary scales occurs between adjacent central scales. The number of intercalary scales touching a central scale is eight in most cases, but nine and 10 also occur.

The more central and typical parts of the Venezuelan carapace differ from these type fragments of *A. depressa* in being more uniformly hexagonal, with the central scale area relatively less posterior and the intercalary scales more uniform and regular. Some scutes, mostly of smaller size and less central position, are, however, closely similar to those of the *A. depressa* types. These types are inadequate for proper specific diagnosis and dubious as a basis for certain generic recognition, but on the basis of them alone, generic distinction from the Venezuelan fossil is not established.

In 1894, Lydekker placed all the Santacrucian glyptodonts in *Propalaeohoplophorus* and considered *Asterostemma depressa* a synonym of *Propalaeohoplophorus australis*. He figured a *Propalaeohoplophorus* carapace in which there is a small posterolateral area where the scale pattern closely resembles *Asterostemma*. Even in this small part of this one specimen there is a distinction, in that the central scale areas are elevated, rather than flat or depressed as in the *Asterostemma* types. There is some improbability, but not impossibility, that both the original *Asterostemma* carapace fragments were from this minor part of the carapace. The Venezuelan specimen now also shows that the *Asterostemma* pattern may characterize a whole carapace which, as a whole, is clearly distinct from *Propalaeohoplophorus*.

Ameghino continued to insist on the validity of *Asterostemma*, and in 1898 he referred to *A. depressa* the facial part of a skull and figured the upper dentition, which very closely resembles that of *Propalaeohoplophorus* except that the posteroexternal lobe is less clearly grooved (vertically) on the sixth and seventh teeth. Ameghino did not give explicit evidence for referring this specimen to *Asterostemma*. Scott (1903) restudied the specimen and gave a new figure of the upper dentition. He said that this was associated with *Asterostemma*-like plates. These, however, were not figured or described. Scott emphasized the dental peculiarity noted above, although it must be granted that the distinction from *Propalaeohoplophorus* is very slight and that the latter shows great variability, the limits of which are not well established. Scott also referred to *Asterostemma* an unusual tail

sheath, basis for the reference being a specimen in the Ameghino collection with a similar sheath fragment associated with *Asterostemma*-like carapace scutes.

Since Scott's work, *Asterostemma* has regularly been accepted as a valid genus, without further establishment of its characters.

In comparison with the Venezuelan fossil, a complication is introduced by the lower dentition. Lower dentitions have been described by Ameghino (especially 1891, 1898) and Scott (1903) in *Propalaeohoplophorus*, *Cochlops*, and *Eucinepeltus*. With one exception, all these described dentitions differ decisively from the Venezuelan fragment in having the first two teeth much simpler and different in outline. The exception is the type of *Propalaeohoplophorus minus* Ameghino, 1891. There is no statement as to associated scutes in this specimen, and the reference to *Propalaeohoplophorus* is not clearly substantiated. Scott (1903) referred a *Propalaeohoplophorus* carapace to *P. minus* (which name he emended to *P. minor*), but this specimen lacks the lower jaw, and the specific reference is not very certain. It is possible that the type mandible of *"P." minus* belongs to *Asterostemma*, in view of the fact that a somewhat similarly complex lower dentition is associated with an *Asterostemma*-like carapace in the Venezuelan specimen.

The resemblance in degree of complexity does not extend to possibly important details of the pattern. The wear surfaces of the first two teeth are more elongate in the Venezuelan specimen, and the second tooth lacks the two vertical ridges on the outer face seen in the type of *"P." minus*. The latter also has the anterior lobe of the third tooth of normal width and squarely posterior to the second tooth, rather than narrow and internal (lingual) as in the Venezuelan specimen.

This is a complicated series of uncertainties. In any case, the Venezuelan specimen is clearly distinguishable from any genus except *Asterostemma*. It cannot now be definitely distinguished from *Asterostemma*, and it is therefore tentatively placed in that genus. In view of the inadequacy of knowledge of true *Asterostemma*, failure to distinguish this better specimen from that genus is by no means equivalent to establishment of a positive generic association. If the Venezuelan specimen does prove positively to belong to *Asterostemma*, then the validity of that genus will be confirmed and its characters more fully established. There remains, however, the distinct possibility that the Venezuelan specimen belongs in a distinct genus not defined from the Argentine.

BEARING ON AGE AND CORRELATION

According to Mr. Todd (personal communication), the type of *Asterostemma venezolensis* is from a deposit considered about middle Miocene in age by the oil geologists and of approximately the same age as the exposure near Zaraza where the mammal *Xenastrapotherium christi* (see Stehlin, 1928) and the turtle *Podocnemis geologorum* (see Simpson, 1943) were found. *Asterostemma venezolensis* tends to confirm these conclusions in a general way.

In terms of Argentine provincial ages, *A. venezolensis* is different from and more primitive than the known Mesopotamian or later glyptodonts and resembles forms from the Colhuehuapian, Santacrucian, and Friasian. Closest resemblance is with Santacrucian glyptodonts. The rather progressive lower dentition and fair size of the animal suggest, inconclusively, post-Colhuehuapian and perhaps even post-Santacrucian age, although a minority of Santacrucian specimens may be as advanced. Unfortunately nothing is known of Friasian glyptodonts except that they occur and are of more or less Santacrucian aspect (see Kraglievich, 1930). The glyptodonts of the Chasicoan are unknown. Very tentatively, the Santacrucian is considered lower Miocene, the Friasian middle Miocene, the Chasicoan middle to upper Miocene, and the Mesopotamian upper Miocene (see Simpson, 1940).

Asterostemma venezolensis is thus consistent with middle Miocene age for the de-

posit. It could be somewhat older but is not likely to be much, if any, younger. In view, however, of the wide geographic separation from the Patagonian forms with which alone comparison is now possible, there remains the chance that *A. venezolensis* is a conservative form younger than its Argentine allies or a precocious form older than the latter. Comparison of *Xenastrapotherium* with Argentine fossils leads to almost identical conclusions as to possible correlation.

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